The iron isotope compositions of Barberton komatiites: insights into early Earth differentiation processes

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Archean komatiite suites provide a unique window into the composition of the early Earth mantle, planetary differentiation and major mantle melting processes. Komatiites from the Barberton Greenstone Belt (BGB) in South Africa are particulary useful because they document a ~ 300 Ma magmatic record that can be used to explore secular changes in mantle source region and partial melting processes. These rocks display distinctive heavy rare earth and high field strength element depletions/enrichments that distinguish them from younger komatiites and imply derivation from specific mantle source regions that were apparently mixed away by the late Archean. Radiogenic Nd, Hf and Os isotope data for these komatiites are consistent with derivation from deep-seated mantle reservoirs generated during late-stage magma ocean crystallization involving fractionation of bridgmanite and Ca-perovskite phases [1,2].

Iron stable isotopes are a geochemical tool that can be used to explore variations in mantle redox state and source mineralogy [e.g. 3-5]. Importantly, Fe isotopes are relatively insentive to the effects of alteration, crustal contamination and late accretion. Experimental data suggests that bridgmanite should display a distinctive Fe isotope composition relative to other lower mantle phases [6]. We present new Fe isotope data for komatiites from the 3.48 Ga Komati and 3.26 Ga Weltevreden Formations and the 3.55 Ga Schapenburg Greenstone Remnant of the BGB. Our preliminary data indicate that significant differences in Fe isotope systematics existed between these komatiite systems, providing evidence for Fe isotope heterogeneity in the early Archean mantle inherited from core formation and early mantle ocean differentiation processes.

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